regular observations at Manila and a few scattered series due to Karl Semper thirty or forty years ago.

The handbook consists of three volumes, aggregating nearly 1,400 pages. The first volume is introductory, and relates to the elements of climate most worthy of observation and reduction, and to the different leading forms of climate, such as land climate, sea climate, and alpine climate, and under each is discussed the particular problems of general character that relate to it. It is to be noted that the idea of monsoons and monsoonal influences are decidedly extended in this edition, and the impression produced in going over it is strong that the monsoonal exchange plays a more important part in explaining the general phenomena of rainfall outside the regions habitually traversed by general storms than has heretofore been taken for granted. The second volume is devoted to tropical climate, and the third to that of the temperate and polar zones. The work of American meteorologists is copiously used, and in an appreciative way, and Dr. Hann always has a good word to say for the lonely settler of scientific tastes in the less frequented parts of the world who has the courage and industry to devote his leisure time to adding his contribution to the settlement of these world-wide problems. The entire work is a thorough, painstaking, and well digested compendium of what is known about the climates of the world, and there is no other book on the subject to compare with it. It is to be hoped that the amiable and learned author will live to issue several more editions of the work.

THE EFFECT OF APPROACHING STORMS UPON SONG BIRDS.

By CHARLES E. LINNEY, Section Director (dated September 12, 1898).

During the night of the 15–16th of August, 1898, very severe electrical, wind, and rain storms prevailed over the northern district of Illinois, reaching their greatest severity in Henry, Knox, Stark, and Bureau counties. The edges of the storm, however, spread eastward to Lake Michigan, northward to Wisconsin, and southward to Warren, Peoria, and Woodford counties.

A large number of my crop correspondents and voluntary observers commented on the extreme severity of the storm, the large amount of water which fell (in many cases exceeding 5 inches), and the heavy, constant, and near display of thunder and lightning. Among the card comments received was one from Mr. W. W. Warner, of Warner, Henry County, Ill., a station which was right in the midst of the most severe portion of the storm area. Mr. Warner said:

> Five and one-half inches of rain fell during eight hours of Monday night (15th) last. * * * It was a great electrical storm. * * * We have lots of birds, wild singers; for forty-eight hours before the great electrical storm not a sound was heard from our wild birds.

This statement in regard to the effect of the approaching storm upon the wild song birds was so full of interest that I wrote to Mr. Warner for additional information, supplementing it by a letter of inquiry to about twenty-five other reporters and observers scattered throughout the area covered by the storms.

Mr. Warner's reply to my letter requesting particulars contains the following:

> Replying to your favor of the 24th instant, in regard to the effect of storms on birds, I would say that I am the owner of some 1,200 acres here on which I allow no hunting; consequently I have lots of birds, friendly wild birds. My house is in a park of about 50 acres of mostly natural growth trees.
>
> The birds commence singing about daylight; several of the scarlet tanagers, which are quite tame, usually lead, and I think in no place in this climate have I heard so many and so great a variety of song birds as here, more in the morning, but usually continuing during most of the day.
>
> I have been in monsoons, hurricanes, etc., but the storm of the 15–16th, I think, exceeded anything I ever saw in the heavy and continuous thunder and vivid flashes of lightning. It lasted nearly eight hours, and some rain gauges showed 6.0 to 6.5 inches of rain.
>
> The day previous to the storm it was very still, with hot air, and I remarked to several: "Have you heard any birds?" etc. "Are we going to have a big storm or an earthquake?"
>
> I have traveled over 200,000 miles, looking over this planet, and on several occasions have observed the wild birds being silent before storms—electrical storms—and before earthquakes, volcanic eruptions, etc.
>
> In the first part of May, 1893, I was in Ceylon. Birds were numerous and noisy. One hot, still day the birds were all quiet. I inquired of my guide, "Where are the birds to-day?" He shook his head and said, "Big storm come." Next night the storm came; a deluge, with heavy and continuous thunder and lightning; killed two Cingalese and the horse they drove, a few feet from me.
>
> In March, 1886, I was on Mauna Kilauea, the volcano, and I noticed the birds did not sing. On the night of the 4–5th there were forty-three earthquake shocks felt, the bed of the crater broke down, etc.
>
> In June, 1893, I was over the same mountain, and the birds were numerous, happy, and noisy, and no unusual storms occurred, nor were there eruptions of the volcano.
>
> I might name other instances, but I might weary. I am sure, however, that in some things our wild birds know more than we.

From the many replies received to my letter of inquiry the following extracts may be interesting.

Prof. F. U. White, voluntary observer, Galva, Henry County, says:

> I have often noted that birds became silent upon the near approach of a storm, or gave desultory notes and went into hiding, especially before our afternoon thunderstorms when the sky became suddenly overcast and dark, with premonitory gusts, and even in the calm preceding these. I have never known nor before heard of animals being affected so far in advance of a storm as Mr. Warner gives in his note.

Mr. T. W. Stoner, crop reporter, Henry, Marshall County, says:

> I have been a close observer of the birds. Yes, they seek a safe place and keep perfectly quiet just before a storm, but I don't think they do as long a time before as Mr. Warner says. The brown thrush, robin, quail, and meadow lark will perch on some object off the ground, as the fence or tree, and sing for a long time occasionally before a rain. In fact many consider them something of a barometer. It appears that they have an instinct or knowledge of an approaching storm, and after it is over their songs and rejoicings are delightful. I am a warm friend of the birds.

Mr. C. N. Butt, voluntary observer, Knoxville, Knox County, says:

> I did not notice any change in the song of the birds at the time you speak of, but I have frequently noticed swallows and other birds, especially whip-poor-wills, in the afternoon when cloudy or threatening weather came before a rain, flying high in the air. I supposed they were catching gnats or flies for food.

Dr. Frederick A. Powell, voluntary observer, Henry, Marshall County, says:

> Many people to whom I have spoken about your letter of inquiry tell me that they often notice a restless movement among birds before a severe storm.

Mr. W. I. Greeley, voluntary observer, Tiskilwa, Bureau County, says:

> I did not notice any difference on the 15th, but have always considered it a sign of rain when robins sang on tops of trees. I have made inquiries; one farmer said he was going to thrash on the 16th, but he thought it looked very much like rain on the night of the 15th. He had pea fowls which always made a good deal of noise before a rain and they were quiet, he noticed it and thought it peculiar.

Mr. Wm. Marriott, crop reporter, LaMoille, Bureau County, says:

> I will here mention one or two things we noticed and my family spoke of. One was the screeching of the pea fowls; they kept up quite a racket on the day and evening before the storm. My wife spoke of it to me.

Mr. John A. Ettinger, crop reporter, Adeline, Ogle County, says:

> Robins, while in their season here, give warning of rainstorms by their unusually loud and persistent singing.

Mr. E. Stevens, crop reporter, Lena, Stephenson County, says:

I am not an ornithologist, only a farmer, but the habits of birds, insects, and animals have ever been a matter of interest to me. I have often watched them before a storm. While I can not recollect noticing the entire silence of birds for so long a time before a coming storm, they certainly do seem possessed of instinctive knowledge of coming storms. My observation leads me to say that parent birds are very active, and therefore too busy to sing, in providing food for their young often hours in advance of a storm. Nesting birds seem to hurry their work and make every possible preparation for the coming storm. You will scarcely ever see a wild bird on the wing after the storm breaks. While they do not sing, they frequently utter calls to their mates and "give orders." Some birds fly away out of the range of the storm.

Mr. W. C. Vandercook, crop reporter, Cherry Valley, Winnebago County, says:

When I was a boy an old hunter and trapper boarded in our family one winter. He often told how bluejays would yell and act excitedly before a hard blow, and often called our attention to the fact that there would be a hard wind within twenty-four hours, which invariably came to pass. It became so impressed on my mind that I often notice it and say to my family that there will be a hard wind because the jays are screaming. This is noticeable during the winter and spring more especially for the jay is a very quiet bird during the summer, hardly ever making a noise unless in defense of its young.

Mr. R. Williams, voluntary observer, Streator, Lasalle County, says:

I lived on a farm for twenty-five years, and during that period I can not recall an instance of so long an interval of silence before any visible sign of an approaching storm. Birds during the nesting season seem to sing more, just before a rain.

Mr. Charles A. Love, voluntary observer, Aurora, Kane County, says:

My father used to speak of the birds singing in an unusual manner in the mornings just before an ordinary rainstorm. Of course the air carries sound better during the quiet, early daylight just before a rain, for the air is saturated then; but I never heard of the birds not singing before an approaching storm. In the light of experiences which have been recorded in the WEATHER REVIEW, of the burning of kite wires in a clear sky by electricity, I can partially realize how the birds which fly high can discern the approach of a storm and seek refuge accordingly. The sensorium of the sweet singers at the surface may be so delicate that the approach of a welcome rain may be heralded forth by chirps and song, and before the awful scourge of hail and lightning stroke be warned away.

An investigation of our text books on meteorology fails to disclose any special comment on the subject of the effect of approaching storms upon birds. Admiral Fitz Roy says in his Weather Book:

Many animals and birds, most insects—even fishes—are acutely sensitive of changes in the air, which can only be accounted for readily by considerations of temperature, moisture, perhaps tension, and varying degrees of electricity.

A statement which is about as much on the subject as any of the writers give, most of them overlook it entirely.

A number of weather proverbs have been found which speak of the effect of approaching storms upon birds, but there are few in regard to our song birds, most of them being in regard to the flight or action of seagoing birds. I find a few, however, which seem to verify the observations of Mr. Warner, among these are the following:

When birds cease to sing, rain and thunder will probably occur.

If birds in general pick their feathers, wash themselves, and fly to their nests, expect rain.

It is said that parrots and canaries dress their feathers and are wakeful the evening before a storm.

If the peacock cries when he goes to roost, and, indeed, much at any time, it is a sign of rain.

Long and loud singing of robins in the morning denotes rain.

Robins will perch on the topmost branches of trees and whistle when a storm is approaching.

The restlessness of our domestic animals and barn yard fowls before an approaching storm is well known and many of their peculiarities have been noted, but I think this is the first time that the silence of song birds has been spoken of, and even more that they should be prophets of approaching storms is indeed a novel and interesting thing. That such is the fact, however, Mr. Warner's observations through many years and much travel, seem to verify.

PROGRESS IN THE EXPLORATION OF THE AIR WITH KITES AT THE BLUE HILL OBSERVATORY, MASSACHUSETTS.

By A. LAWRENCE ROTCH, Director.

(Read before Section B. A. A. A. S., Boston Meeting, August, 1898.)

Besides various brief accounts of the work at Blue Hill, a detailed description by Mr. Fergusson of the apparatus employed, with a discussion by Mr. Clayton of the meteorological results, until February, 1897, has been published this year as an Appendix to the Blue Hill observations for 1896, in Annals of the Astronomical Observatory of Harvard College, Vol. XLII, Part I.

Many improvements have been made in the apparatus, with the assistance of a grant from the Hodgkins fund of the Smithsonian Institution to obtain meteorological records at heights exceeding 10,000 feet. The single surface Eddy kite has been abandoned and the rectangular cellular form of Hargrave has been perfected by making it larger, more rigid, and relatively lighter, while by concaving the surfaces exposed to the wind the lifting power of the kite is increased. A recent kite of this type has a lifting surface of 90 square feet and weighs 11 pounds.[1] Mr. Lamson's folding aerocurve kite has superposed curved surfaces in front and superposed plane surfaces in the rear, each pair presenting a dihedral angle to the wind. This kite has attained the greatest height. In general, it may be said that our kites, with a short line, rise from 50° to 60° above the horizon and exert a traction of 1 pound per square foot of lifting surface in a wind blowing 20 miles an hour. Elastic bridles diminish the angle of incidence as the wind pressure increases, thereby enabling the kites to fly in gales.

The meteorographs made by M. Richard, in Paris, record three elements and weigh about 2.75 pounds, but one recently constructed by Mr. Fergusson, of the observatory staff, records barometric pressure, air temperature, relative humidity, and wind velocity, and yet weighs only 3 pounds with the aluminum case which protects the recording part from the weather. Much attention has been given to the exposure of the thermometer, and it is believed that the true temperature of the free air is now obtained whenever the meteorograph remains at nearly the same height during a few minutes.

The drum of the first steam windlass was crushed by the accumulated pressure of the coils of wire. A new steam windlass, with a strain pulley, constructed by Mr. Fergusson in 1897, on the principle of Sir William Thompson's deep-sea sounding apparatus has proved entirely successful. It has devices for measuring the length of wire uncoiled and continually recording its traction, and during the reeling in for automatically distributing it on the storage drum.

Since the use of wire in 1896, and with more efficient kites, the heights attained have been greatly increased. Thus the extreme heights of the meteorograph above the hill in all the flights prior to 1896 averaged about 1,000 feet, whereas its height during all the flights of the past three months was about 7,000 feet, and during the month of August, 1898, 7,800 feet. On five occasions the height of 10,000 feet has been exceeded, and on October 15, 1897, records were brought down from an altitude of 11,086 feet above the hill, which were printed in facsimile in the MONTHLY WEATHER REVIEW for September, 1897. The maximum height thus far attained was on August 26, 1898, when five kites, having a combined

[1] The standard size adopted for all Weather Bureau kite stations gives about 70 square feet of surface and weighs about 8 pounds. The Marvin meteorograph weighs about 2.1 pounds and records continuously wind velocity, barometric pressure, air temperature, and relative humidity. The apparatus was designed specially for daily ascensions up to 5,000 feet, at a regular time of day at numerous stations. Frequently 8,000 feet is attained, but higher flights are not sought for at present. The superiority of one large kite over a tandem of several small ones was early shown by Professor Marvin.—ED.